Tanta University	Department: Computers and Automatic Control Eng. Total Marks: 100 Marks	Faculty of Engineering

Course Title: Communication systems	Course Code: EEC2247	Second Year
Date: June 24, 2011 (second term)	Allowed time: 3 hrs	No. of Pages: (2)

Answer all the following questions:

Question (1) (20 degrees)

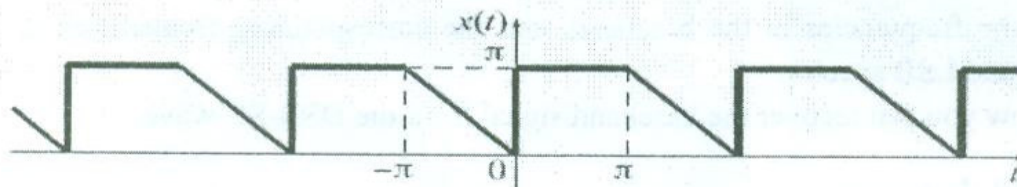(1) Find the trigonometric Fourier series for the periodic waveform shown in Figure (1).

Figure (1)

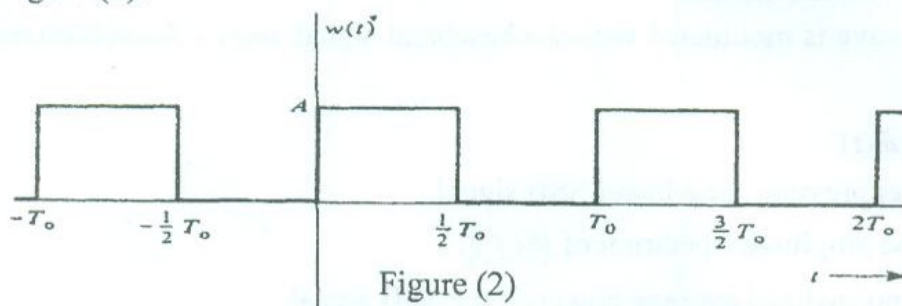(2) Find the complex Fourier series and the PSD for the periodic square waveform shown in Figure (2).

Figure (2)

(3) Use the Fourier series representation of a periodic train of impulses to prove that

$$\sum_{n=-\infty}^{\infty} \delta(t - nT) = \frac{1}{T} \sum_{n=-\infty}^{\infty} e^{j2\pi nft}$$

then, find its Fourier transform and draw its spectrum.

(4) State the Parseval's theorem and the Dirichlet's conditions.

Question (2) (20 degrees)

(1) Determine the Fourier transform of the following function:

(a) $x(t) = (\cos(5t) + e^{-2t})u(t)$

(b) $rect.(\dfrac{t-2}{4}) + 8\sin(6\pi t)$

(2) If $w(t) = e^{-2t}$, find its Fourier transform, then find X(f) that satisfies the following relationships:

(a) $x(t) = w(2t + 2)$

(b) $x(t) = e^{-jt} w(t - 1)$

(c) $x(t) = \dfrac{d^2 w(t)}{dt^2}$

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Question (3)   (20 degrees)

(1) Explain with the mathematical representation, how the switching modulator can be used to generate the AM wave.

(2) If a carrier wave $c(t)=A_c \cos(2\pi f_c t)$ is amplitude modulated by a baseband signal $m(t)$, show how you can obtain a DSB-SC wave by using a double balanced modulator.

(3) For the baseband signal $m(t)=2\cos(2000\pi t)$, determine the following:

    (a) The spectrum of $m(t)$.

    (b) The spectrum of the DSB-SC signal $m(t)\cos(20,000\pi t)$.

    (c) Identify the frequencies in the baseband, and the corresponding frequencies in the USB and LSB spectra.

    (d) Show how you can recover the baseband signal from the DSB-SC wave.

Question (4)   (20 degrees)

(1) State the benefits of using SSB modulation over the DSB modulation.

(2) Shows with the block diagram, how you can generate the SSB wave by using the phase discrimination method.

(3) A SSB-AM wave is modulated with the baseband signal $m(t) = 5\cos(1000\pi t)$, , with $A_c = 1$.

    (a) Evaluate $\widehat{m}(t)$.

    (b) Find the expression for a lower SSB signal.

    (c) Sketch the amplitude spectrum of $|S(f)|$.

    (d) Find the normalized average power of the SSB signal.

Question (5)   (20 degrees)

(1) Design FM transmitter that is based on the indirect method to transmit audio signals containing frequencies in the range of 50 Hz to 15 kHz. The narrow-band phase modulator is supplied with a carrier wave of frequency $f_1 = 0.2 MHz$. Assume the final carrier frequency of the FM required is $f_c = 100 MHz$, the maximum frequency deviation $\Delta f = 75 kHz$ and the frequency of the intermediate crystal oscillator $f_2 = 8.5 MHz$.

(2) Show with the block diagrams the types of FM wave's demodulators and the principal of the operation of each one.

(3) A single-tone FM signal is given by $s(t) = 10\sin[16\pi \times 10^6 t + 20\sin(2\pi \times 10^3 t)] volts$. Determine the modulation index, frequency deviation, the carrier power, and calculate the bandwidth of the FM signal using Carson's rule.

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Good Luck   Dr. *Entessar Said*

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